doi:10.2489/jswc.66.5.337

Adoption of the Conservation Reserve Enhancement Program in the New York City watershed: The role of farmer attitudes

A. Armstrong, E.J. Ling, R. Stedman, and P. Kleinman

Abstract: Despite widespread adoption of conservation practices by farmers in the Cannonsville watershed, part of the New York City water supply system, there is considerable resistance to riparian buffer practices of the Conservation Reserve Enhancement Program (CREP). Traditional approaches to promoting CREP adoption, based on the adoption-diffusion model, were not effective in promoting CREP. We surveyed farmers in the Cannonsville watershed to evaluate factors affecting CREP adoption. Many variables commonly tied to practice adoption, including farm structure and farmer sociodemographic traits, were poorly correlated with the attitudes of Cannonsville farmers toward CREP. Attitudes toward land costs and farmer resentment toward New York City's control of land and conservation policy were, however, strong predictors of CREP adoption. This suggests that as regional watershed collaborations become more active in managing private landowner conservation behaviors, resentment factors may inhibit adoption of the encouraged practices. Findings provide insight into mechanisms to improve upstream-downstream partnerships and the potential to balance clean water resources with local agricultural production priorities.

Key words: adoption/diffusion—Conservation Reserve Enhancement Program—farmer attitudes—watershed management

The Conservation Reserve Enhancement Program (CREP) was authorized under the Federal Agriculture Improvement and Reform Act of 1996 Farm Bill to coordinate federal and nonfederal resources to improve water quality, erosion control, and wildlife habitat on agricultural land. Nationwide, CREP is an important riparian protection program, providing farmers with incentives and support for best management practices (BMPs), including riparian buffer development. In the northeastern United States, CREP has been a popular tool in expanding streambank fencing on pastures. However, in the Cannonsville watershed (figure 1), part of the Catskill-Delaware branch of New York City's water supply system, participation of farmers in CREP has historically been limited, despite widespread participation in New York City's Watershed Agriculture Program.

Watershed Agriculture Program. The New York City Watershed Agriculture Program (NYCWAP) was founded in 1992 out of conflict over maintaining agricultural viability while avoiding filtration of New York City's drinking water. The NYCWAP is administered by a council of local farmers, agribusiness and environmental leaders, and representatives of the New York City Department of Environmental Protection, the US Environmental Protection Agency, and several state agencies (Pires 2004). County soil and water districts, state (Cornell Cooperative Extension) and national (USDA Natural Resources Conservation Service) agencies all have employees who work with farmers under the rubric of the NYCWAP. Since 1992, whole farm plans have been developed for 93% of Cannonsville watershed farms on a voluntary basis (James 2005). These plans are supported by 100% cost-sharing funds derived from multiple sources, particularly New York City and the USDA.

New York City Conservation Reserve Enhancement Program. The New York City CREP is administered by the NYCWAP with the goal to remove highly erodible and riparian lands (Pires 2004) from production, thus enhancing water quality in the New York City drinking water system. The CREP outcomes are participant driven, meaning that without voluntary participation, potential water quality (James et al. 2006; Teels et al. 2006) and wildlife habitat improvements (Oneal et al. 2008) would not be realized. A major difference between the New York City CREP and other CREPs nationwide is that the USDA and the NYCWAP equally cover 100% of BMP implementation costs. Typically, most CREP cost-sharing arrangements involve participant investment. In line with the national Conservation Reserve Program, of which CREPs are a part, annual rental payments for the life of the contract (10 to 15 y) are paid based on the base soil rental rate, which is calculated from a weighted soil rental rate of three predominant soils (USDA CCC 1998). Cannonsville farmers are provided two additional incentive payments: a one-time signing payment of \$100 ac^{-1} (\$40.50 ha^{-1}) and a practice incentive payment, worth 40% of the total BMP implementation cost received at the end of installation. New York City CREP farmers may be eligible for additional incentive payments depending on their specific contracts, operations, and landscape conditions. Even though 100% cost sharing is available for fence construction and buffer installation, farmers are responsible—both in labor and monetary costs—for maintaining these over the contract duration (USDA NRCS 1997).

In the Cannonsville watershed, CREP participants may fence out 35 to 150 ft (11 to 46 m) along stream corridors (James 2005), implement filter strips, or restore wetlands (USDA CCC 1998). Additional practices supported under CREP include planting grasses, shrubs, trees, or other vegetative cover (USDA CCC 1998) and may also include structural features (e.g., livestock crossings, watering systems) sponsored by the

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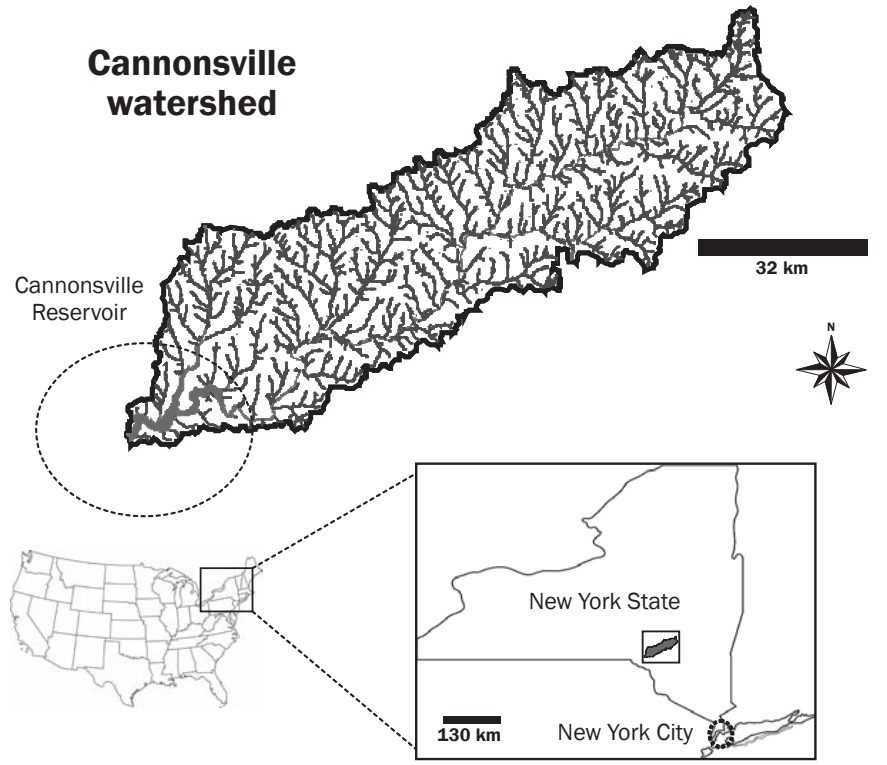
Journal of Soil and Water Conservation 66(5):337-344 www.swcs.org

Figure 1
Location of the Cannonsville Reservoir and its watershed, part of the New York City water supply system.



NYCWAP. The type and number of practices and structures installed on a particular CREP farm depends on the management of the operation, farmer willingness, and landscape characteristics. According to the 2008 New York City Filtration Avoidance Report, 43.6 ac (17.6 ha) containing 3.6 stream mi (5.8 stream km) were enrolled in CREP in 2008, bringing the total CREP–protected riparian acreage to slightly less than 2,000 ac (809 ha) or 185 stream mi (298 km) (NYC DEP 2009). The NYCWAP seeks to enroll 150 additional CREP ac (60.7 ha) annually (NYC DEP 2009).

Historical Basis for Resentment Toward New York City. The New York City water supply system is composed of 19 reservoirs that provide about 1.4 billion gal (5.3 billion L) of drinking water per day to nine million New York City metro area residents (National Research Council 2000). In 1905, the New York State legislature allowed for the New York City Board of Water Supply to acquire by eminent domain lands outside of City jurisdiction for reservoir development (Pires 2004). New York City's reservoirs came at a cost to watershed inhabitants, displacing residents and confiscating private land holdings as early as 1915 to build reservoirs (Pires 2004). The Cannonsville reservoir, part of the Catskill-Delaware system, was the last constructed in the supply system (Pires 2004). In 1966, nearly 20,000 ac (over 8,000 ha), including 94 farms and five towns, were flooded (Galusha 1999). Nearly 1,000 residents were forced off their land, with many offered only 50% of the assessed property valuation (Platt et al. 2000). The combination of forced evictions, low payments for land acquisitions, and the economic blow (e.g., loss of towns and farmland with flooding, restrictions in commercial development) to watershed residents and townships created considerable animosity towards New York City and its endeavors (Pfeffer and Wagenet 1999).

Reservoir development was only the beginning of tensions between downstate water interests and upstate watershed residents. The Surface Water Treatment Rule of 1989 mandated filtration for all public surface water supplies, including the Catskill-Delaware system. In response, New York City revised their 1953 watershed rules and regulations to, among other things, propose riparian setbacks around the water supply reservoirs and waterways (National Research Council 2000). These proposed New York City drinking water mandates galvanized local opposition, particularly among watershed farmers, who estimated a 25% loss of tillable land under the proposed regulations (National Research Council 2000). This controversy ultimately resulted in the development of the NYCWAP (Pfeffer and Wagenet 1999). New York City concurrently proposed acquisition of all undeveloped land around waterways through purchase or conservation easement (Pfeffer et al. 2005). Thirty rural communities united to form a Coalition of Watershed Towns and jointly filed a lawsuit against New York City for attempting to enforce the proposed regulations (Platt et al. 2000). The legal and political animosity between watershed towns and New York City was formally resolved with the 1997 Memorandum of Agreement among New York City, watershed communities, the US Environmental Protection Agency, New York State, and environmental organizations. The Memorandum of Agreement waived the filtration requirement, with the stipulation that New York City must maintain a watershed control program, including detailed rules and regulations on local land use to minimize contamination potential (National Research Council 2000).

A central and contentious component of the watershed control program is New York City's self-identified "aggressive" land acquisition initiative, which sets annual acreage solicitation goals, or land purchase offers, carried out by its Department of Environmental Protection as well as the NYCWAP (Pfeffer and Wagenet 1999; NYC DEP 2009). Between 1996 and 2009, New York City increased the number of acres owned from 35,608 ac to 102,688 ac (14,410 ha to 41,560 ha), or about 13.5% of the total Catskill-Delaware watershed (1.012 million ac [409,500 ha]) (NYC DEP 2009). These figures understate the presence of New York City in the watershed, as the New York City Department of Environmental Protection, NYCWAP, New York State, or open space entities own 30.4% (23,230 ac [9,400 ha]) of all riparian areas of the total watershed (NYC DEP 2009). Along with regulations (e.g., stormwater control, wastewater treatment) and partnerships with local entities such as the NYCWAP, New York City uses land acquisition in the Catskill-Delaware sys-

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tem as its predominant tool for water quality protection (Pires 2004).

It was in this setting of perceived urban control over rural communities that resentment likely arose. Many Cannonsville farmers were vehemently opposed to New York City Department of Environmental Protection attempts to regulate agricultural production, particularly the proposed stream corridor setbacks (Pfeffer and Wagenet 1999). Therefore, riparian exclusions may carry a symbolic significance to watershed farmers.

Streambank fencing is seen by the NYCWAP as a crucial strategy for maintaining or improving water quality in the Cannonsville watershed (James et al. 2006). We sought to identify factors affecting farmer attitudes and behaviors toward CREP. If resentment towards New York City still exists among Cannonsville watershed farmers, how is that resentment expressed in terms of CREP adoption? We hypothesized that CREP adopters hold more positive attitudes than nonadopters towards the NYCWAP and less strongly associate CREP with New York City's water supply policies. A survey was developed and mailed to all farmers in the watershed, with the objectives of describing CREP adopters and linking specific attitudinal variables to CREP adoption (or nonadoption). We hypothesized that, in addition to traditional adoption variables (age, education, political ideology, and off-farm income), resentment of New York City's control leads to CREP nonadoption.

Materials and Methods

Study Area. The Cannonsville watershed (291,000 ac [117,800 ha]; 42°21'N, 74°52'W) is located approximately 150 mi (240 km) northwest of New York City, predominantly in Delaware County, New York. The Cannonsville area has a working landscape tradition, particularly in dairy farming among other commercial agriculture and forestry operations. In 2007, the average market value of agricultural products sold in Delaware County was $73,820 per farm, with a net cash income of $17,583 per farm (USDA NASS 2009). Financial incentives for soil and water conservation help supplement this income. Within the Cannonsville watershed, hydrologic factors, overlaid with agricultural production, necessitate conservation measures to minimize contamination of water resources. Soil conditions limit the vertical movement of water, resulting in abundant surface water in streams and seeps (Walter et al. 2001). Because most farms are located in valley bottoms in close proximity to this surface water, nonpoint source pollution, particularly nutrients, sediment, and pathogens derived from manure and fertilizers, poses a threat to water quality.

Mail Survey. During the summer of 2004, a mail survey instrument was sent to all identified farmers (including participants and nonparticipants in the NYCWAP) in the Cannonsville watershed (n = 205). Contact information for farmers participating in the NYCWAP was acquired from the NYCWAP. Information for those not participating in the NYCWAP was obtained using data compiled by the NYCWAP and the local soil and water conservation district. A modified four-contact mailing procedure (Dillman 2000) with a $20 incentive given upon survey completion resulted in 120 completed and returned surveys (59% response rate).

Data Analysis. Survey questions concerning farmer attitudes were organized into two topics: attitudes towards water quality and attitudes towards CREP. All attitude questions used a five-point Likert scale that ranged from "strongly agree" to "strongly disagree." Water quality attitudinal questions included the importance of CREP–related behaviors (such as livestock fencing out of streams) and attitudes towards the NYCWAP and New York City's other water quality protection efforts. Farmer attitudes toward CREP were operationalized with questions regarding the costs (e.g., land taken out of productivity), incentives (e.g., money and farm infrastructure improvements), and maintenance of CREP fencing. An additional set of survey questions measured farm structure variables and assessed the presence of BMPs.

Differences between adopters and nonadopters of CREP were evaluated using t-tests for the difference between independent sample means. We used a principal component factor analysis with varimax rotation and Kaiser normalization to identify categories of influential farmer attitudes. Five attitude scales, composed of farmer attitudinal questions, were created and tested for face validity. The attitudinal scales and variables identified in the factor analysis underwent means substitution for missing values. We then created a logistic regression model to explicate the multiple factors affecting adoption and nonadoption. The model included three areas of potential influence: (1) farmer attitudes (including external resentment), (2) farmer characteristics, and (3) farm characteristics. The strength of the relationship between attitudinal variables and CREP adoption was assessed by Nagelkerke R^2. All data were analyzed in SPSS, version 16.0.

Results and Discussion

Sociodemographic Characteristics of Adopters and Nonadopters. Half (n = 60) of survey respondents had adopted CREP, and 12% indicated that they had not adopted CREP but would be enrolled in the next year or would like to be enrolled in the future. Thirty-eight percent of respondents indicated that they did not have CREP and did not want to be enrolled. Eighty-three percent of respondents reported having a whole-farm plan, which is the essential first step of becoming involved with the NYCWAP. Seventy percent of respondents have or were planning to have barnyard improvements within a year, 76% have or were planning to have a nutrient management plan, and 73% have or were planning to have a manure management plan.

Differences in farmer characteristics showed that adopters were significantly older than nonadopters (mean = 61 years old for adopters versus 55 years old for nonadopters, $p < 0.05$), but had been farming for significantly fewer years (mean = 28 years for adopters versus 35 years for nonadopters, $p < 0.01$) (table 1), suggesting that older, retired farmers, or those that had taken up farming later in life, had enrolled in CREP to supplement their income. This was inconsistent with the literature, which said that increased age was negatively related to conservation practice adoption (Prokopy 2008)—yet there was little evidence that this relationship applies to land retirement programs. Adopters were significantly more politically liberal than nonadopters (mean = 3.16 versus 3.48 on the five-point Likert scale, $p < 0.10$) and were significantly more likely to be affiliated with environmental organizations (16% of adopters versus 5% of nonadopters, $p < 0.10$). Adopters were also significantly more likely to seek conservation information from multiple sources, including extension agents or consultants (62% of adopters versus 47% of nonadopters, $p < 0.10$) and NYCWAP personnel (52% of adopters versus 36% of nonadopters, $p < 0.10$), which was consistent with findings related to other conservation

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Table 1
Farmer and farm characteristics that significantly differ between Conservation Reserve Enhancement Program (CREP) adopters and CREP nonadopters.

	Mean response	
Farmer characteristics	**CREP adopters**	**CREP nonadopters**
Years farming***	28 years	35 years
Farmer age***	61 years	55 years
Years family farming**	56 years	79 years
Get information from "other" sources**	16%	5%
Political orientation (scale: 1 = very liberal, 5 = very conservative)*	3.16	3.48
Membership in environmental organizations*	16%	5%
Get information from extension agents or consultants*	62%	47%
Get information from WAC*	52%	36%
Farm characteristics		
Use near-stream areas for hay production (%)***	14%	36%
Use near-stream areas for flood control (%)**	10%	2%
Number of acres owned cropland**	131 ac	61 ac
Use near-stream areas for "other" nonlivestock uses (%)*	9%	2%
Dependence on streams for livestock in pasture (scale: 1 = none, 5 = all)*	3.54	4.02
Farms with dairy cattle (%)*	33%	19%
Number of heifers or young stock*	63 head	36 head
Number of acres owned of "other" land*	134 ac	79 ac

*$p < .10$ **$p < .05$ ***$p < .01$

practices (Buttel et al. 1990; Rhodes et al. 2002; Greiner et al. 2009). Contrary to the Prokopy et al. (2007) metaanalysis, adoption was not related to education level.

There were also significant differences in farm characteristics between CREP adopters and nonadopters. Adopters of CREP were significantly more likely to own dairy cattle (33% of adopters versus 19% of nonadopters, $p < 0.10$), particularly young stock (63% of adopters versus 36% of nonadopters, $p < 0.10$) (table 1). Land ownership and use also differed between CREP adopters and nonadopters; adopters owned more acres of cropland (mean = 131 ac [53 ha] for adopters versus 61 ac [24.7 ha] for nonadopters, $p < 0.05$) and more land classified as "other" (e.g., forested) (mean = 134 ac [54.2 ha] for adopters versus 79 ac [32.0 ha] for nonadopters, $p < 0.10$) than nonadopters. Those enrolled in CREP were significantly less likely to report using near-stream areas for hay production (14% of adopters versus 36% of nonadopters, $p < 0.01$) and were significantly less reliant on streams for pastured livestock than nonadopters (mean = 3.54 for adopters versus 4.02 for nonadopters, $p < 0.01$) (scale 1 = none, 5 = all). These findings support the notion that adopting farms are more equipped to incur loss of productive land than nonadopting farms (Buttel et al. 1990). The CREP adopters did depend on near-stream areas for flood control (10% of adopters versus 2% of nonadopters, $p < 0.05$) and other nonlivestock uses (9% of adopters versus 2% of nonadopters, $p < 0.10$) significantly more so than nonadopters.

Categorizing Attitudes Towards the Conservation Reserve Enhancement Program. The factor analysis classified attitude items with one another as they related to CREP adoption. This analysis produced five categories of attitudes (table 2), four of which were tested for reliability as attitude scales: land cost ($\alpha = 0.672$, two items), external resentment ($\alpha = 0.729$, five items), innovation ($\alpha = 0.744$, three items), and CREP maintenance ($\alpha = 0.633$, two items). Two of these categories are traditional factors commonly used to explain practice adoption: innovation attitudes, which are measures of propensity towards risk (e.g., Atari et al. 2009); and, economic costs (e.g., Napier et al. 2008; Suter et al. 2008), represented herein as land costs. The land costs scale included attitudes related to the overall amount of land taken up by CREP as well as land removed from crop production and grazing—it contains strictly land loss, not compensation for time and implementation, which aligned with the external resentment factor. The CREP maintenance scale consisted of two items in which respondents expressed attitudes towards time, money, and difficulty required for CREP fencing maintenance. The external resentment scale includes multiple dimensions of New York City's involvement in the Cannonsville watershed, including protection of water quality for New York City, outreach and education to change farming practices, and maintenance of agricultural vitality within the watershed. The factor analysis revealed that agreement with NYCWAP priorities was similar to satisfaction with CREP payments. This analysis shows that those who are satisfied with NYCWAP water quality efforts are also satisfied with the New York City CREP. Conversely, those who disagree with protecting water for New York City are also likely to disagree with NYCWAP priorities, and by extension, CREP incentive amounts. We term this scale "external resentment" based on the multifaceted disapproval for New York City watershed policies represented by the items therein. In addition to the four attitudinal scales, we identified two attitude variables that did not mesh within the above factors: traditionalism, or adherence to traditional farm management techniques and private property rights—included here due to the importance of private property values in the New York City water supply system (Pfeffer et al. 2005). The traditionalism and private property rights variables have not typically been considered in the adoption literature. While it is clear that they are important to the context of the Cannonsville watershed, it is also likely that they contribute to practice adoption in other settings.

The CREP adopters held significantly less resentment towards New York City than nonadopters, meaning that they were more likely to agree with pro-New York City statements (mean = 3.39 for adopters versus 3.09 for nonadopters; on a five-point Likert scale, $p < 0.05$) (table 3). Adopters were also significantly more tolerant of land costs associated with CREP than were nonadopters (mean = 3.11 for adopters versus 2.26 for nonadopters, $p < 0.01$). The traditionalism variable was the only other attitudinal measure identified in the factor analysis that significantly differed between adopters and nonadopters (mean = 2.73 for adopters versus 3.08 for nonadopters, $p < 0.10$).

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Table 2
Principle component factor analysis of farmer attitudes affecting Conservation Reserve Enhancement Program (CREP) enrollment. Questionnaire statements with loadings are represented in the corresponding attitudinal scales. A loading is the amount of influence an item has in forming a factor. Loadings less than 0.30 are omitted. SR = scale reliability.

	Attitudinal components				
Questionnaire statement	External resentment SR = 0.729	Innovation SR = 0.744	Land cost SR = 0.672	CREP maintenance SR = 0 .633	Tradition SR = 0.098
I agree with the priorities of the NYCWAP for farmers in Delaware and Schoharie Counties.	0.819				
The incentive payments given to farmers enrolled in CREP are enough.	0.733				
The NYCWAP has helped me meet new farmers and other agriculture experts and learn new ways of farming.	0.670				
Since the NYCWAP was formed, many farmers are doing better now than they were before.	0.660				
Protecting and/or improving the quality of water for New York is important to me.	0.604		0.479		
I am always looking for new and faster ways to do farm tasks.		0.881			
I keep my eye out for technologies and machines that may make my job easier.		0.874			
I think a lot about how my actions today will affect my herd and land in the future.		0.757			
The amount of land fenced out by CREP is too much.			–0.835		
I'm not worried about losing land for crop production and grazing fenced out by CREP.			0.736		
Keeping up the fence and trees in a CREP area would not take that much extra time or money on my part.				0.842	
Difficulty maintaining trees, fences, bridges and crossings on your farm (scale 1 to 5 with 1 = difficult and 5 = easy)				0.835	
I manage my farm the way my family members did before me.					0.916

Table 3
Conservation Reserve Enhancement Program (CREP) adopters and nonadopters—mean responses to the attitudinal factors identified in the factor analysis. Attitudes were measured on a five-point Likert scale: 1 = strongly agree, 5 = strongly disagree.

	Mean response		
Attitudinal factors	CREP adopters	CREP nonadopters	*p*-value
Land costs attitudes	3.11	2.26	$p < 0.01$
Resentment attitudes	3.39	3.09	$p < 0.05$
Tradition attitudes	2.73	3.08	$p < 0.10$

Farmer Attitudes and Conservation Reserve Enhancement Program Adoption—Multivariate Logistic Regression. We developed a binary logistic regression model with three categories of predictive variables: farmer attitudes (land cost, external resentment, innovation, CREP maintenance, traditionalism, private property rights); farmer characteristics (education, political ideology, the presence of off-farm income, and the proportion of other local farmers known on a first name basis); and farm structure (presence of dairy cattle, crop acreage, pasture acreage) (table 4). Our model resulted in a Nagelkerke R^2 of 0.448 ($p < 0.05$), with 73% of respondents correctly classified: 68.1% of nonadopters, and 77.4% of adopters. The only significant relationships ($p < 0.05$) found in the final model were the land cost ($p = 0.000$) and external resentment scales ($p = 0.037$). The odds ratio for land cost attitudinal scale (3.67) indicates that for every unit increase along the five-point Likert scale (i.e., towards stronger disagreement with the negatively phrased attitudinal measures), there is a 270% increase in the odds that a farmer will not enroll in CREP. Conversely, the external resentment odds ratio (2.57) shows that for every Likert unit increase (towards disagreement with the positively phrased attitudinal measures), the odds that a farmer will enroll in CREP increases 157%. Innovation and maintenance attitudes, along with private property rights attitudes and traditionalism attitudes, were not significant predictors of CREP adoption.

The number of crop acres owned by individual respondents was a marginally significant farm characteristic predictor of CREP enrollment ($p < 0.10$). In contrast to much of the earlier adoption-diffusion research, no farmer sociodemographic variables influenced CREP enrollment.

Traditional Adoption-Diffusion Strategies and Upstream-Downstream Interests. Federal soil and water conservation programs and regional watershed partnerships promote and administer many voluntary conservation strategies for agricultural landowners.

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Table 4
Binary logistic regression results predicting CREP enrollment. Dependent variable: Are you currently enrolled or planning to enroll in CREP? (0 = No; 1 = Yes).

Independent variables	Beta	se	Wald	Sig.	Odds ratio
Farmer attitudes					
Land costs	1.300***	0.375	12.043	0.001	3.668
External resentment	1.082 **	0.476	5.168	0.023	2.952
Innovation	0.176	0.527	0.111	0.739	1.192
Maintenance	–0.022	0.330	0.005	0.946	0.978
Private property	0.309	0.333	0.861	0.353	1.362
Traditionalism	–0.247	0.290	0.724	0.395	0.781
Farmer characteristics					
Education	–0.139	0.184	0.565	0.452	0.871
Proportion local farmers known	–0.249	0.237	1.101	0.294	0.780
Off-farm income presence	0.633	0.522	1.466	0.226	1.882
Political ideology	0.120	0.318	0.142	0.706	1.127
Farm characteristics					
Dairy cattle presence	0.683	0.632	1.169	0.280	1.980
Number of crop acres owned	0.009*	0.005	3.163	0.075	1.009
Number of pasture acres owned	0.002	0.004	0.281	0.596	1.002
Model statistics					
Constant	–8.456	3.470	5.937	0.015	0.000
Nagelkerke R-Square	0.448				
n	100				

Notes: se = standard error. Sig. = Significance. *n* = sample size.
*$p < .10$ **$p < .05$ *** $p < .01$

Our study demonstrates that variables in the adoption-diffusion tradition (i.e., farm characteristics and farmer sociodemographic attributes) do not tell us much about adoption of CREP in the Cannonsville watershed. Here, supporting attitudes for the NYCWAP and the face of New York City as perceived by local residents were more predictive of CREP adoption than environmental attitudes. This suggests that factors found in the traditional adoption-diffusion model may not apply particularly well here or in other watersheds controlled by outside interests.

The adoption-diffusion model has been used to assess the probability of implementation of a wide variety of soil and water conservation practices, including soil management (Nowak 1987), non-CREP riparian buffers (Ryan et al. 2003), and most other agricultural conservation practices (Prokopy 2008). This model considers, among other factors, the social system in which adoption and diffusion takes place (Nowak et al.1983; Nowak 1987; Parker et al. 2007). Originally defined as "a set of interrelated units that are engaged in joint-problem solving to accomplish a common goal" (Rogers 2003), the nature of the social system is context dependent. In the Cannonsville watershed, attitudinal variables rooted in the local concerns (i.e., perceived production costs and resistance to land-use constraints for the benefit of distant others) are significant predictors of adoption. Our results demonstrate the importance of external resentment in this setting, where downstream water quality interests are changing local land management. Unlike early adoption-diffusion studies where the implementing landowner assumes some environmental benefit from adoption (i.e., reduced soil loss) (Pampel and van Es 1977), the Cannonsville watershed context is markedly different: farmers are asked to change their land-use practices by outside regulators for downstream benefit. This calls into question the concept of a "common goal." New York City's goal is to avoid water filtration costs, and in doing so, compensates farmers for retiring riparian land. Our factor analysis showed that landowners who believe protecting New York City water is important hold very different attitudes than those who would agree to additional compensation for land retirement. Therefore, we believe that the adoption-diffusion models must take into account the history of upstream-downstream relationships in shaping contemporary attitudes and behaviors.

Addressing External Resentment in Conservation Reserve Enhancement Program Implementation. As previously noted, New York City's first action towards filtration avoidance was to propose highly contentious waterway setback and riparian buffer requirements, which were then followed by NYCWAP formation, and then direct collaboration with farmers. While local water quality is improved under CREP and other BMPs such as streambank fencing (James et al. 2006), our results showed that farmers' attitudes towards protecting water quality for New York City are one significant component of the resentment variable. Protecting local water quality was not a significant reason for CREP adoption. As shown in the factor analysis (table 2), concern about protection of New York City's water was interconnected with attitudes towards CREP payments and the NYCWAP. Farmers with positive attitudes towards conserving New York City water are likely to support the NYCWAP and its filtration avoidance efforts. In contrast, landowners who hold negative attitudes towards New York City or NYCWAP priorities (e.g., filtration avoidance via riparian setbacks) are also likely to be unsatisfied with CREP payments and to disagree with the idea that NYCWAP has improved farmer wellness. This interrelationship among negative attitudes towards CREP, New York City water, and perceived farmer wellbeing signifies underlying resentment towards New York City filtration avoidance activities in the watershed. In other words, landowner attitudes towards New York City's extensive outside control of local water resources have discouraged CREP adoption. These findings are consistent with more detailed analyses of farmer resentment in the New York City watershed as conducted by Pfeffer and Wagenet (1999) and Pfeffer et al. (2005).

Farmer resentment is very much tied to the type and location of land loss under CREP. Satisfaction with CREP payments remained distinct from the land costs attitude scale, suggesting that farmers think about land (i.e., opportunity cost) differently than they do about out-of-pocket costs. The significant land-costs variable, which represents farmer attitudes towards productivity loss and amount of land retired under CREP (and to a lesser extent, their association with protecting New York City water quality) (table 2),

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mirrors farmer-led opposition to the mid-1990s proposed riparian setbacks. The New York City Department of Environmental Protection's land acquisition initiative, which is the heart of their filtration avoidance watershed management strategy (Pfeffer and Wagenet 1999; NYC DEP 2009), is an ever-present reminder of historical conflict. Some farmers may perceive CREP as a symbol of New York City's land acquisition program, a realistic possibility considering that CREP is promoted and administered in part by the NYCWAP. Other reasons for CREP resistance may include a loss of riparian pasture, cropland, and water sources for livestock—outcomes of streambank fencing that potentially decrease productivity compared to barnyard improvements or whole-farm plans, which are more frequently adopted by Cannonsville farmers. As previously noted, adoption of riparian BMPs requires farmers or landowners to commit to the program for 10 to 15 years, making enrollment unattractive to those with short-term planning horizons (Force and Bills 1989; Soule et al. 2000). Similarly, these contracts impose land-use restrictions, so landowners with strong feelings about personal property rights may be less likely to participate.

Understandably, Cannonsville farmers may not readily embrace the idea that they are responsible for the quality of New York City's water supply. However, similar regional watershed partnerships (e.g., Chesapeake Bay watershed, Sacramento River watershed) increasingly represent a common model of watershed management. Such partnerships integrate downstream water quality outcomes and upstream management practices for more comprehensive policies (National Research Council 1999). As Clean Water Act total maximum daily loads and regional watershed partnerships continue to emerge across the United States, it will become ever more important to understand and respond to external resentment and its potential impacts on conservation practice adoption.

We believe that programs such as CREP must consider the role of broader issues, such as historical relationships, in order to ensure widest adoption of practices. Initiatives that confront external resentment should involve collaborative discourse and social interaction between government agencies and local farmers (Plummer and FitzGibbon 2006) that directly speak to the history of New York City's engagement in the watershed. Activities to address resentment should not replace those to improve environmental attitudes (e.g., environmental education, watershed-based community outreach), as these attitudes clearly emerged as separate concerns in our study. The balance between upstream stakeholder involvement and downstream environmental objectives is often cited as the greatest obstacle for an effective watershed partnership (Huitema et al. 2009).

Venues for collaboration and interaction present opportunities for farmer feedback to the conservation agency, addressing concerns about whether the practice fits into the farmer's routine and whether the practice is being properly implemented and maintained. If farmers feel a sense of stewardship towards the structures and practices, even in a setting of local costs for external water quality benefits, this may improve farmer commitment to conservation. Open dialogue between farmers and the NYCWAP that acknowledges historical reasons for lingering resentment may also improve underlying farmer attitudes, which we see here are critical to CREP adoption.

Summary and Conclusions

The CREP has met with much success in protecting water quality and restoring riparian systems in the New York City watershed and the nation (NYC DEP 2002; USDA FSA 2007). The Cannonsville CREP is different from CREP in many other regions due to New York City's historical involvement in water supply management. Our research in the Cannonsville watershed emphasized the importance of historical and contemporary conservation policies in assessing the probability of CREP adoption. The watershed has several particular characteristics that have shaped our results: most notably, sizeable economic incentives and historical land-use policies that led to local, perhaps even regional, perceptions (Breakey 2009) that farmers are paid to provide clean water to the New York City metropolitan area. To what degree, then, do our findings apply to other settings? The Cannonsville watershed shares certain structural characteristics—such as conservation initiatives generated, funded, and enforced by institutions outside the local area—with other watersheds. As metropolitan areas and watershed collaborators across the United States strive to ensure clean water resources, watersheds governed under regional partnerships may become more common. The lessons learned here are useful for understanding local support or resistance towards conservation initiatives in related watershed management contexts. We recommend that watershed managers in other regional partnerships seek early engagement with local landowners to clarify management goals and to consider local perspectives. Engagement via more direct communication with landowners may circumvent external resentment between government agencies and local residents.

Acknowledgements

We would like to thank the staff of the New York City Watershed Agriculture Council and its associated New York City Watershed Agriculture Program, the New York City Department of Environmental Protection, and the USDA Natural Resources Conservation Service in Walton, New York, for their assistance in the conduct of this study.

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